TECHNICAL REPORT BRL-TR-3053

BRL

DEGRADATION OF HAWK AIR DEFENSE UNITS OPERATING IN A HOT/HUMID CHEMICAL ENVIRONMENT

JOHN A. MORRISSEY
CHARLES H. WICK

NOVEMBER 1989

U.S. ARMY LABORATORY COMMAND

BALLISTIC RESEARCH LABORATORY
ABERDEEN PROVING GROUND, MARYLAND

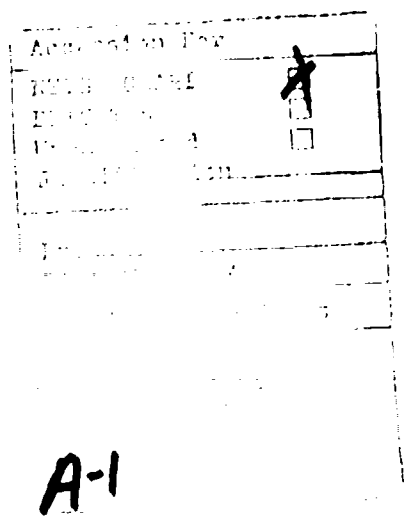
DESTRUCTION NOTICE

Destroy this report when it is no longer needed. DO NOT return it to the originator.

Additional copies of this report may be obtained from the National Technical Information Service, U.S. Department of Commerce, Springfield, VA 22161.

The findings of this report are not to be construed as an official Department of the Army position, unless so designated by other authorized documents.

The use of trade names or manufacturers' names in this report does not constitute indorsement of any commerical product.



A-1

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

Form Approved OMB No. 0704-0188

1a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY	3. DISTRIBUTION / AVAILABILITY OF REPORT Approved for public release: Distribution is unlimited.
2b. DECLASSIFICATION / DOWNGRADING SCHEDULE	
4. PERFORMING ORGANIZATION REPORT NUMBER(S) BRL-MR-3053	5. MONITORING ORGANIZATION REPORT NUMBER(S)
6a. NAME OF PERFORMING ORGANIZATION U.S. Army Ballistic Research Laboratory 6b. OFFICE SYMBOL (*If applicable*) SLCBR-VL-I	7a. NAME OF MONITORING ORGANIZATION
6c. ADDRESS (*City, State, and ZIP Code*) Aberdeen Proving Ground, MD 21005-5066	7b. ADDRESS (*City, State, and ZIP Code*)
8a. NAME OF FUNDING / SPONSORING ORGANIZATION 8b. OFFICE SYMBOL (*If applicable*)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
8c. ADDRESS (*City, State, and ZIP Code*)	10. SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO. / PROJECT NO. / TASK NO. / WORK UNIT ACCESSION NO.

11. TITLE (*Include Security Classification*)

Degradation of HAWK Air Defense Units Operating in a Hot/Humid Chemical Environment

12. PERSONAL AUTHOR(S)

John A. Morrissey and Charles H. Wick

13a. TYPE OF REPORT	13b. TIME COVERED FROM _____ TO _____	14. DATE OF REPORT (*Year, Month, Day*)	15. PAGE COUNT

16. SUPPLEMENTARY NOTATION

17. COSATI CODES			18. SUBJECT TERMS (*Continue on reverse if necessary and identify by block number*)
FIELD	GROUP	SUB-GROUP	Degradation, Regression, MOPPIV, HAWK

19. ABSTRACT (*Continue on reverse if necessary and identify by block number*)

The degradation of personnel wearing individual protective equipment (IPE) was quantified for a HAWK Assault Fire Unit operating in a hot and humid enviroment. The average temperature was 84°F and the average relative humidity was 74%. Correction factors which are the inverse of the degradation were determined for eighteen unit tasks and 47 individual component tasks. These factors when multiplied by the time to perform the task in Battle Dress Uniform provide a time estimate and most probable range for the time to perform a similar task while wearing IPE. All tasks were completed with results indicating moderate personnel degradation caused by the IPE. Correction factors for all tasks ranged from 1.1 to 2.7. It is evident that short term tasks can be completed under these environmental conditions.

20. DISTRIBUTION / AVAILABILITY OF ABSTRACT	21. ABSTRACT SECURITY CLASSIFICATION
☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT ☐ DTIC USERS	UNCLASSIFIED
22a. NAME OF RESPONSIBLE INDIVIDUAL Charles H. Wick	22b. TELEPHONE (*Include Area Code*) 278-6342
	22c. OFFICE SYMBOL SLCBR-VL-I

DD Form 1473, JUN 86 *Previous editions are obsolete*

SECURITY CLASSIFICATION OF THIS PAGE

UNCLASSIFIED

TABLE OF CONTENTS

LIST OF TABLES

1. INTRODUCTION

1.1 Background. Troop performance degradation due to chemical protective equipment has been of increasing concern to military commanders. This protective equipment is worn in one of four configurations referred to as Mission Oriented Protective Posture (MOPP) levels. MOPPIV posture, during which all equipment is worn and sealed, is the most protective and the most bulky, cumbersome and restrictive mode. Personnel are protected at the expense of their encumbrance, a circumstance which results from impeded physiological functions including vision, hearing, speaking, manual dexterity and others. Usually, this encumbrance produces degradation in the form of increased time to complete tasks and in some cases reduced accuracy. In order that these degradations might be quantified for use in simulations, war gaming, and other studies of unit effectiveness and combat readiness, field studies are deemed necessary since laboratory exercises typically introduce artifacts that can bias results.

A portion of an extensive DoD-sponsored and Dugway Proving Ground-administered (DPG) program, referred to as DO-49, was implemented to satisfy the required need for field testing and to quantify the effect of wearing MOPPIV on personnel performing military tasks. The current program includes five specific operational study areas scheduled for operations testing in cold, moderate and hot temperatures, which are Maintenance Operations, Armor Operations, Signal Operations, Missile Operations, and Night Recon Operations.

The Vulnerability and Lethality Division of the Ballistic Research Laboratory (BRL) has an extensive ongoing program for estimating the vulnerability of military systems on the integrated battlefield to include the effects of conventional, nuclear, and chemical munitions on the effectiveness of various units. The model for this program is the Army Unit Resiliency Analysis (AURA) methodology.[1] AURA utilizes inputs from all areas that impact on the ability of a unit to accomplish a mission, which includes the effect of wearing MOPPIV. Since degradation data is not available in many areas and because of the need to include degradation performance in unit effectiveness studies using AURA, the BRL developed an algorithm[2] to estimate personnel degradation due to MOPPIV. In this report, MOPPIV refers to wearing the equipment at level IV and MOPPIV time to the amount of time required to complete a task while wearing level IV.

One major concern in interpreting field data is the need to establish a degradation value. It is not unusual to find judgements made on the effect of protective equipment with no real estimate of the effect or the variation experienced. One purpose of this effort is to provide a numerical estimate of the equipment effect and the associated variation.

This report presents the results of the fourth MOPPIV investigation, Missile Operations. This study was conducted in a warm environment with temperatures ranging between 80° and 95°F with high humidity at the Cherry Point Marine Corps Air Station in Cherry Point, North Carolina, from 5 August through 15 August 1985.

1.2 Objective. The primary objective of this program was to quantify the degradation of a HAWK Assault Fire Unit (AFU) performing its air defense maneuvers while dressed in complete chemical protective ensemble (MOPPIV). These measurements included:

the ability of AFU team members to perform individual tasks, and
the overall effectiveness of the unit.

2. APPROACH

2.1 Overview. The measure of degradation for the missile trials was the time difference between performing the task in Battle Dress Uniform (BDU) and MOPPIV. For these trials there were three AFU teams, each required to emplace and march order the five end items listed in Table 1. Emplacement includes such tasks as raising the wheels, leveling the end item, and making the unit operational. March order includes such tasks as lowering the wheels and securing all equipment for road travel. A large part of both emplacement and march order duties is the handling of power and data cables, a very labor-intensive task.

TABLE 1. HAWK Degradation AFU End Items.

End Item	Acronym
Platoon Command	PCP
Continuous Wave Acquisition Radar	CWAR
High Power Illuminator Radar	HIPIR
Launcher	LCHR
Pulse Acquisition Radar	PAR[a]

[a] Usually associated with larger unit.

A trained observer, whose goals were to time and rate the degradation for all tasks was assigned to each end item. All times were recorded in elapsed time. Also, the times for unit accomplishments, such as end item to the PCP, alignment were recorded by the observer assigned to the PCP. These times were recorded in clock time.

Individuals were trained in the appropriate Military Operation Specialty (MOS), and they had previously worked together as an AFU. The crews were familiar with MOPPIV but had received no special training for these trials.

Since these tests were repetitive, individuals would gain experience as they progressed through the trials. In an effort to control and later estimate the experience effect, a record was noted on the order of start, first time in BDU or first time in MOPPIV. For the purposes of this analysis, all references to first-time effect are pertaining to the first iteration, first trial for each AFU.

Three items of data were available for analysis: 1) the time to complete a task, both individual and unit; 2) the protective profile (BDU/MOPP); and 3) whether it was the first trial or a subsequent one. During the complete test series, a video camera was assigned to each end item and the tasks were recorded as they were being performed. The tasks to be recorded were selected prior to the start of the test series. These tasks were selected because of an anticipated difficulty or movement modification due to wearing MOPPIV gear. These records of the events will be maintained for reference and future study.

A complete meteorological record was maintained for the trials. These data are reported in Appendix A. For most days the temperature was in the upper 80s and low 90s with very high humidity (greater than 50%).

A multiple linear regression technique was used to estimate the effect of the chemical protective equipment and the effect of practice on the total time to complete the measured tasks.[3]

2.2 Trial description. The trials were designed to exercise an AFU as a complete air defense unit. Each trial was composed of several iterations, each consisting of the emplacement and march order of the unit. Each day's trial was designed to perform a maximum number of iterations in the first six hours of the test day. For the complete six-hour session, the members of the AFU performing the test remained in the uniform required for the day's testing. After the morning session, the AFU members were given an hour lunch break, during which time the uniform constraint was lifted. The afternoon session followed and was limited to one or two additional iterations. This restriction was imposed by the requirement to vacate the test area and allow the testing personnel to have their evening meal.

These trials were designed to study each end item as a unique group of tasks and to look at the platoon overall efficiency as a group of unit tasks. A short description of each end item, its function, and the tasks performed follows.

2.2.1 Platoon Command Post (PCP). The PCP is the main control center of the HAWK. During an air defense mission, the PCP would control the tracking, selection, and firing at the target. For this particular exercise, the Identification Friend or Foe (IFF) antenna was remoted. This required removing the IFF antenna from the roof of the PCP van and placing it at a distance of approximately 25 m. This task also required placement of additional cables and an additional alignment task for the PCP crew. Certain tasks, such as removal of the IFF antenna and laying the cable, are very labor intensive; while others, such as end item alignment, require much physical dexterity. Communication is an important requirement for all end items, especially for the PCP because of its central role in the AFU operation. No attempt was made to monitor the conversations between end items and measure the communication difficulties, which might be created by the MOPPIV gear, because it was felt that any communication difficulties would be reflected in the task times.

The PCP timed tasks, which are listed in Table 2, were performed by five Marines. These personnel consisted of one operator, in the 7222 MOS series, and two technicians, in the 5920 MOS series. The platoon commander, AFU leader, was part of the PCP crew.

2.2.2 Continuous Wave Acquisition Radar (CWAR). The target aircraft as it approaches the HAWK site is detected by the Pulsed Acquisition Radar (PAR) on the site perimeter. After detection, the tracking of the target is "handed off" to the CWAR by the PCP control. The CWAR then tracks the target until the target is within attack distance. The operation of the CWAR requires labor intensive tasks such as cable handling, and physical dexterity tasks such as alignment and electronic module adjustments.

The CWAR tasks, which are listed in Table 3, were performed by three Marines. This group consisted of two operators with an MOS Series of 7222 and one technician with an MOS series of 5920.

2.2.3 High Power Illumination Radar (HIPIR). After the incoming target aircraft has approached within attacking distance, the target is handed off to the HIPIR for final tracking. Upon launch of the HAWK missile, the target is illuminated by the HIPIR and the reflected radar signal is the homing signal for the launched missile.

TABLE 2. PCP Timed Tasks and Subtasks.

Task number	Task
1	Emplace the PCP a. ground PCP
2	Lay cables
3	Emplace IFF antenna for remote operations
4	Align IFF to base piece
5	Perform daily checks
6	Perform daily IFF checks
7	Prepare PCP for march order a. stow IFF antenna b. roll and secure all cable

TABLE 3. CWAR Timed Tasks and Subtasks.

Task number	Task
1	Emplace the CWAR a. ground the CWAR b. level the CWAR
2	Energize the CWAR
3	Perform daily check on the CWAR
4	Orient and align the CWAR as a base piece
5	Prepare the CWAR for march order a. secure the antenna protective cover b. roll and secure cables

The HIPIR operation had the most labor intensive and physically demanding tasks. The cable handling tasks are greatly increased because there is a factor of two more cables. The leveling and alignment of the HIPIR required that the technician's head be positioned in a small, not easily accessible area, to observe the leveling bubble. This became more difficult while wearing the mask. Monitoring the instrument panels and fine tuning the electronic modules required fine motor movements. Communication was another problem because of the physical layout of the HIPIR chassis. The transmitter and receiver electronics packages were on opposite sides of the chassis, and communication was required between operators at each section during the initial setup and checkout of the electronic systems. The timed tasks of the HIPIR are listed in Table 4.

TABLE 4. HIPIR Timed Tasks and Subtasks.

Task number	Task
1	Emplace HIPIR a. remove and stow antenna protective covers b. level HIPIR
2	Align HIPIR to base piece
3	Perform daily checks
4	Prepare the HIPIR for march order a. secure antenna, vent covers and hoods b. roll and secure all cables

2.2.4 Launcher-loader. The launcher section for an AFU has three launcher units with three missiles attached to each. For these trials, only one launcher unit was used with only a single inert missile attached to avoid damage to the costly equipment. An integral part of the launcher section is the loader unit used to transfer the missiles, three at a time, from the missile carriers to the launcher. For these tests, only the one dummy missile was transferred.

The operation of the launcher unit required labor-intensive tasks, physically demanding tasks, and communication between team members. This communication problem was particularly important for the missile transfer. The personnel for the unit consisted of eight Marines, five operators, and three technicians. The tasks are listed in Table 5.

TABLE 5. Launcher-Loader Timed Tasks and Subtasks.

Task number	Task
1	Emplace launcher a. level launcher
2	Remove missile from truck mounted storage pallet
3	Align the launcher to the HIPIR
4	Launcher preload check
5	Transfer missile to launcher
6	Lock missile to launcher
7	Perform SATO checks on missile
8	Arm the missile
9	Unload the missile from the launcher a. position launcher boom for unloading b. transfer missiles from launcher to pallet
10	Prepare the launcher for travel a. remove and stow the stakes

2.2.5 Pulsed Acquisition Radar (PAR). Although the PAR is not an end item for an AFU, the unit was included as part of these trials because of the labor intensive operation of emplacing and march ordering the unit. In normal operation, the PAR would be assigned to a battery and is used for long range enemy detection. The detected aircraft is tracked until close enough to the battery to be handed off to the CWAR by the Battery Command Center (BCC).

The assembly of the PAR unit in MOPPIV gear was a difficult and tedious task. This operation required not only the normal labor intensive tasks such as laying and gathering cables, but also the added tasks of lifting and handling large and bulky antenna parts. The erection of the antenna required personnel to handle antenna parts atop the antenna unit, approximately 5 m above ground level. These tasks required extreme caution by the personnel involved. The timed tasks associated with the PAR are listed in Table 6.

TABLE 6. PAR Timed Tasks and Subtasks.

Task number	Task
1	Emplace PAR a. level PAR b. assemble antenna c. install antenna reflector
2	Energize PAR
3	Prepare PAR for march order; disassemble and stow a. omnidirectional antenna b. antenna reflector

3. FIELD DATA

The recorded times for the individual tasks of each end item for the daily trials are reported in Appendix B. As was stated in the previous section, unit times were recorded by the trained observer assigned to PCP. These data could be interpreted as a summary of the daily individual tasks and are reported in Tables 7-15.

During these trials several participants did not complete their portion of a task because of concern for heat stress. Team members were able to assume their duties to complete the unit task. This did not happen during the Yuma trials.[3] The humidity was considered to be the greatest problem and, when combined with high temperatures, caused the early endings to trials because "black flag" (training restriction) conditions existed.

4. DATA ANALYSIS AND DISCUSSION

A regression analysis was used to analyze the data.[4] This section presents regression analyses for each end item task and for unit tasks.

The regression technique provided two values for calculating a correction factor (CF) and a probable range, these are: T_o, which is the practiced, unencumbered time and a, the uniform correction. An additional value b is given, which represents the first time correction. The b value was determined simply to remove this effect from the correction factor calculation. The MOPPIV degradation for any particular task is defined as:

$$T_o / (T_o + a).$$

TABLE 7. 5 August 1985 - BDU, Unit Time Data.

Task	Unit	Iteration number 1A-1B	1A-2B	1A-3B
		Time, minutes		
Emplace	CWAR	12.0	12.0	18.0
	LCHR	18.0	18.0	12.0
	HIPIR	0.0	30.0	12.0
IFF	Remoted	42.0	18.0	12.0
	Linked to PCP	1.4	36.0	18.0
Orientation and alignment	Complete	*	36.0	36.0
ISC	Complete	*	66.0	66.0
Missile transfer	to LCHR	48.0	30.0	18.0
	to pallet	84.0	90.0	78.0
Dailys complete	CWAR	18.0	24.0	24.0
	HIPIR	48.0	48.0	42.0
March ordered	CWAR	150.0	102.0	96.0
	PCP and IFF	150.0	108.0	96.0
	LCHR	150.0	108.0	96.0
	PAR	150.0	102.0	102.0
	HIPIR	144.0	108.0	96.0
AFU operational		132.0	78.0	72.0
Unit march ordered		132.0	108.0	102.0

* No recorded data because of equipment problems.

TABLE 8. 6 August 1985 - MOPPIV, Unit Time Data.

Task	Unit	Iteration number 2A-1M	2A-2M	2A-3M	2A-4M
		Time, minutes			
Emplace	CWAR	18.0	18.0	18.0	18.0
	LCHR	12.0	0.0	18.0	12.0
	HIPIR	6.0	12.0	6.0	6.0
IFF	Remoted	12.0	12.0	12.0	12.0
	Linked to PCP	18.0	18.0	18.0	24.0
Orientation and alignment	Complete	48.0	30.0	30.0	30.0
ISC	Complete	66.0	60.0	48.0	48.0
Missile transfer	to LCHR	18.0	18.0	24.0	18.0
	to pallet	78.0	78.0	60.0	60.0
Dailys complete	CWAR	24.0	18.0	24.0	24.0
	HIPIR	48.0	36.0	42.0	24.0
March ordered	CWAR	96.0	96.0	78.0	78.0
	PCP and IFF	96.0	96.0	78.0	78.0
	LCHR	96.0	90.0	72.0	78.0
	PAR	102.0	102.0	78.0	78.0
	HIPIR	102.0	96.0	84.0	84.0
AFU operational		72.0	66.0	48.0	48.0
Unit march ordered		102.0	102.0	84.0	84.0

TABLE 9. 7 August 1985 - MOPPIV, Unit Time Data.

Task	Unit	Iteration number 3A-1ML	3A-2ML	3A-3ML	3A-4ML
		Time, minutes			
Emplace	CWAR	24.0	18.0	18.0	18.0
	LCHR	12.0	18.0	12.0	6.0
	HIPIR	6.0	6.0	3.0	3.0
IFF	Remoted	12.0	12.0	6.0	6.0
	Linked to PCP	12.0	12.0	12.0	12.0
Orientation and alignment	Complete	24.0	24.0	48.0	24.0
ISC	Complete	48.0	48.0	48.0	30.0
Missile transfer	to LCHR	18.0	24.0	18.0	18.0
	to pallet	48.0	48.0	48.0	168.0
Dailys complete	CWAR	24.0	24.0	18.0	18.0
	HIPIR	30.0	30.0	90.0	24.0
March ordered	CWAR	72.0	66.0	66.0	180.0
	PCP and IFF	66.0	66.0	66.0	174.0
	LCHR	66.0	66.0	66.0	174.0
	PAR	72.0	72.0	72.0	168.0
	HIPIR	66.0	66.0	72.0	180.0
AFU operational		42.0	42.0	42.0	30.0
Unit march ordered		72.0	66.0	72.0	180.0

TABLE 10. 8 August 1985 - MOPPIV, Unit Time Data.

Task	Unit	Iteration number 1B-1M Time, minutes	1B-2M Time, minutes
Emplace	CWAR	18.0	18.0
	LCHR	18.0	12.0
	HIPIR	6.0	6.0
IFF	Remoted	12.0	12.0
	Linked to PCP	18.0	24.0
Orientation and alignment	Complete	102.0	78.0
ISC	Complete	144.0	108.0
Missile transfer	to LCHR	84.0	96.0
	to pallet	174.0	*
Dailys complete	CWAR	48.0	66.0
	HIPIR	120.0	60.0
March ordered	CWAR	198.0	*
	PCP and IFF	204.0	*
	LCHR	174.0	*
	PAR	198.0	*
	HIPIR	204.0	*
AFU operational		162.0	114.0
Unit march ordered		204.0	*

* Trial 1B-2M was stopped for a lunch break at approximately noon. After the break, the trial could not be continued because of rain; the trial was later terminated after the AFU was operational.

TABLE 11. 9 August 1985 - BDU, Unit Time Data.

Task	Unit	Iteration number 2B-1B	2B-2B	2B-3B	2B-4B	2B-5B
		Time, minutes				
Emplace	CWAR	18.0	12.0	12.0	12.0	6.0
	LCHR	12.0	6.0	6.0	12.0	36.0
	HIPIR	6.0	6.0	6.0	6.0	6.0
IFF	Remoted	12.0	6.0	6.0	12.0	12.0
	Linked to PCP	12.0	12.0	6.0	12.0	12.0
Orientation and alignment	Complete	36.0	30.0	24.0	24.0	18.0
ISC	Complete	48.0	48.0	48.0	30.0	48.0
Missile transfer	to LCHR	42.0	36.0	30.0	24.0	42.0
	to pallet	72.0	66.0	54.0	48.0	66.0
Dailys complete	CWAR	18.0	18.0	18.0	18.0	6.0
	HIPIR	42.0	12.0	12.0	18.0	42.0
March ordered	CWAR	84.0	78.0	72.0	60.0	72.0
	PCP and IFF	90.0	78.0	72.0	60.0	78.0
	LCHR	90.0	72.0	72.0	60.0	72.0
	PAR	78.0	78.0	72.0	56.0	72.0
	HIPIR	84.0	84.0	72.0	60.0	72.0
AFU operational		56.0	48.0	42.0	36.0	48.0
Unit march ordered		90.0	84.0	72.0	60.0	78.0

TABLE 12. 12 August 1985 - MOPPIV, Unit Time Data.

Task	Unit	Iteration number 3B-1ML	3B-2ML	3B-3ML
		Time, minutes		
Emplace	CWAR	6.0	6.0	6.0
	LCHR	30.0	18.0	12.0
	HIPIR	12.0	6.0	6.0
IFF	Remoted	18.0	12.0	12.0
	Linked to PCP	18.0	12.0	12.0
Orientation and alignment	Complete	42.0	30.0	24.0
ISC	Complete	60.0	60.0	66.0
Missile transfer	to LCHR	48.0	36.0	36.0
	to pallet	78.0	72.0	78.0
Dailys complete	CWAR	18.0	12.0	12.0
	HIPIR	42.0	12.0	6.0
March ordered	CWAR	90.0	84.0	84.0
	PCP and IFF	90.0	90.0	90.0
	LCHR	90.0	84.0	84.0
	PAR	90.0	84.0	90.0
	HIPIR	102.0	90.0	95.0
AFU operational		66.0	60.0	66.0
Unit march ordered		102.0	90.0	96.0

TABLE 13. 13 August 1985 - MOPPIV, Unit Time Data.

Task	Unit	Iteration number 1C-1M	1C-2M	1C-3M	1C-4M
		Time, minutes			
Emplace	CWAR	12.0	6.0	18.0	6.0
	LCHR	12.0	18.0	24.0	12.0
	HIPIR	12.0	6.0	18.0	6.0
IFF	Remoted	36.0	6.0	18.0	12.0
	Linked to PCP	54.0	12.0	24.0	18.0
Orientation and alignment	Complete	[a]	[a]	72.0	42.0
ISC	Complete	[a]	[a]	84.0	54.0
Missile transfer	to LCHR	42.0	42.0	78.0	48.0
	to pallet	78.0	60.0	96.0	66.0
Dailys complete	CWAR	48.0	12.0	24.0	12.0
	HIPIR	54.0	24.0	24.0	18.0
March ordered	CWAR	90.0	72.0	108.0	84.0
	PCP and IFF	90.0	72.0	114.0	90.0
	LCHR	96.0	84.0	114.0	84.0
	PAR	90.0	72.0	108.0	54.0
	HIPIR	90.0	84.0	114.0	96.0
AFU operational		60.0[b]	48.0[b]	84.0	60.0
Unit march ordered		96.0	84.0	114.0	96.0

[a] Because of a fire in the PCP at the start of trial IC-1M, these tasks could not be completed. Also, alignment was not possible because communications were lacking.

[b] The AFU operational for this trial is defined as all systems operational and the missile mounted. These data were not used in the regression analysis.

TABLE 14. 14 August 1985 - MOPPIV, Unit Time Data.

Task	Unit	Iteration number 2C-1ML	2C-2ML	2C-3ML
		Time, minutes		
Emplace	CWAR	6.0	6.0	6.0
	LCHR	6.0	6.0	18.0
	HIPIR	6.0	6.0	6.0
IFF	Remoted	12.0	18.0	12.0
	Linked to PCP	18.0	18.0	18.0
Orientation and alignment	Complete	42.0	66.0	42.0
ISC	Complete	96.0	96.0	*
Missile transfer	to LCHR	54.0	66.0	36.0
	to pallet	108.0	102.0	*
Dailys complete	CWAR	12.0	24.0	24.0
	HIPIR	18.0	48.0	12.0
March ordered	CWAR	120.0	114.0	*
	PCP and IFF	138.0	126.0	*
	LCHR	126.0	120.0	*
	PAR	120.0	114.0	*
	HIPIR	132.0	126.0	*
AFU operational		96.0	96.0	*
Unit march ordered		138.0	126.0	*

* Trial 2C-3ML was stopped for lunch break and not continued in the afternoon because a RED Flag condition existed with humidity and temperature.

TABLE 15. 15 August 1985 - BDU, Unit Time Data.

Task	Unit	Iteration number 3C-1B	3C-2B	3C-3B	3C-4B	3C-5B
		Time, minutes				
Emplace	CWAR	6.0	6.0	3.0	3.0	3.0
	LCHR	6.0	6.0	6.0	6.0	6.0
	HIPIR	12.0	3.0	3.0	3.0	3.0
IFF	Remoted	12.0	6.0	6.0	6.0	6.0
	Linked to PCP	12.0	6.0	6.0	6.0	6.0
Orientation and alignment	Complete	36.0	18.0	18.0	12.0	12.0
ISC	Complete	96.0	36.0	30.0	24.0	18.0
Missile transfer	to LCHR	36.0	24.0	18.0	12.0	12.0
	to pallet	96.0	42.0	36.0	24.0	24.0
Dailys complete	CWAR	12.0	12.0	6.0	6.0	12.0
	HIPIR	12.0	12.0	12.0	12.0	6.0
March ordered	CWAR	102.0	48.0	42.0	30.0	24.0
	PCP and IFF	108.0	54.0	48.0	36.0	30.0
	LCHR	108.0	54.0	48.0	30.0	30.0
	PAR	102.0	48.0	42.0	30.0	30.0
	HIPIR	114.0	60.0	48.0	36.0	30.0
AFU operational		84.0	36.0	36.0	24.0	18.0
Unit march ordered		108.0	60.0	48.0	36.0	30.0

The MOPPIV correction factor is the inverse of this term and can be used to multiply the time to complete the same task while wearing MOPPIV. A negative a or b indicates that a task was completed in less time by a team wearing MOPPIV or by a less experienced team, respectively. Generally, such results can be attributed to noncorrectable inconsistencies in some team's performance for that task.

4.1 Regression results for end item tasks.

4.1.1 PCP. The PCP tasks require moderate MOPPIV correction. The maximum correction was about 1.8 for two weeks of trials. These data compare favorably to those of the earlier Yuma HAWK AFU trials.[4] The maximum correction for those trials was the performance of dailys, but the cable operations did not show as much effect as was seen in the Cherry Point trials. This result can most probably be attributed to the high humidity. The high correction value for daily checks might again be due to the fact that these checks are performed inside the PCP van, where the lighting is poor and the personnel had masks on. Table 16 lists the regression analysis results for the PCP tasks.

4.1.2 CWAR. The MOPPIV correction factors for the CWAR end item range from 1.4 to 2.0. The operations of the CWAR appeared to be the easiest, and again, the electronic daily checks seemed to require the maximum correction factor. For the CWAR, this might be caused by the manipulation of small electronic switches with the large oversized gloves and the reading of the output meters encumbered by the mask. The results of the regression analysis for the CWAR can be found in Table 17.

4.1.3 HIPIR. The HIPIR correction factors ranged from a low of 1.3 to a high of 2.8. The largest effect was seen in the task of aligning the HIPIR to the base piece. It was mentioned earlier that this task (and leveling the equipment) would be difficult because the operator was forced to cram his head and mask into a small area to view the level bubble. The electronic tuning tasks for the HIPIR were not as affected as they were in the PCP and CWAR. A degradation seen during these trials, which was not observed during the earlier tests at Yuma,[4] was the large correction factor for rolling and securing the cables. This large effect resulted, in part, because a few cable handlers were overcome by the heat; for several trial iterations, therefore, the unit task was accomplished with fewer personnel. These data were used in the regression analysis. A list of the regression analysis results is given in Table 18.

TABLE 16. Regression Analysis - PCP.

Task	Unencumbered term, T_o	Clothing correction, a	Training correction, b	MOPPIV CF/range
1	4.44	1.11 ± 0.73	-1.58 ± 1.24	1.25 1.09-1.41
2	1.29	1.69 ± 0.94	0.25 ± 1.59	2.31 1.58-3.04
3	11.33	8.57 ± 2.98	9.56 ± 4.97	1.76 1.49-2.02
4	6.68	0.65 ± 1.44	10.21 ± 2.89	1.09 0.88-1.31
5	11.75	8.64 ± 4.69	7.91 ± 12.79	1.74 1.33-2.13
6	5.39	3.57 ± 1.76	2.02 ± 3.53	1.66 1.34-1.99
7	3.15	2.36 ± 2.09	21.87 ± 4.15	1.75 1.09-2.41
8	11.47	3.96 ± 1.57	3.65 ± 2.62	1.35 1.21-1.48
9	9.15	2.45 ± 1.25	3.28 ± 2.06	1.27 1.13-1.40
10	8.49	3.35 ± 1.57	4.27 ± 2.59	1.42 1.23-1.60

Task 1 - emplace the PCP
Task 2 - ground PCP
Task 3 - lay cables
Task 4 - emplace IFF antenna for remote operations
Task 5 - align IFF to base piece
Task 6 - perform daily checks
Task 7 - perform daily IFF checks
Task 8 - prepare PCP for March order
Task 9 - stow IFF antenna
Task 10 - roll and secure all cable

TABLE 17. Regression Analysis - CWAR.

Task	Unencumbered tem., T_o	Clothing correction, a	Training correction, b	MOPPIV CF/range
1	6.81	2.89 ± 0.78	3.56 ± 1.33	1.42 1.31-1.54
2	1.19	0.59 ± 0.45	1.35 ± 0.77	1.49 1.12-1.88
3	6.81	2.89 ± 0.78	3.56 ± 1.33	1.42 1.31-1.54
4	3.69	2.05 ± 0.67	-1.52 ± 1.13	1.56 1.37-1.74
5	3.00	_ 2.53	6.10 ± 4.30	2.02 1.17-2.86
6	10.08	9.15 ± 2.98	11.75 ± 5.98	1.91 1.61-2.20
7	7.03	2.95 ± 1.02	5.21 ± 1.70	1.42 1.27-1.56
8	3.75	2.78 ± 1.53	2.59 ± 2.57	1.74 1.33-2.15
9	6.91	3.12 ± 1.01	5.20 ± 1.68	1.45 1.31-1.60

Task 1 - emplace the CWAR
Task 2 - ground CWAR
Task 3 - level the CWAR
Task 4 - energize the CWAR
Task 5 - perform daily check on the CWAR
Task 6 - orient and align the CWAR as a base piece
Task 7 - prepare the CWAR for travel
Task 8 - secure the antenna protective cover
Task 9 - roll and secure all cable

TABLE 18. Regression Analysis - HIPIR.

Task	Unencumbered term, T_o	Clothing correction, a	Training correction, b	MOPPIV CF/range
1	4.15	1.87 ± 0.87	1.57 ± 1.47	1.45 1.24-1.66
2	5.44	2.84 ± 1.58	4.07 ± 2.68	1.52 1.23-1.81
3	9.35	2.42 ± 1.60	2.44 ± 2.71	1.26 1.09-1.43
4	6.53	11.53 ± 4.61	22.30 ± 9.35	2.77 2.06-3.47
5	5.84	6.41 ± 3.44	24.13 ± 5.84	2.10 1.51-2.69
6	11.83	6.84 ± 1.47	1.47 ± 2.44	1.58 1.45-1.70
7	9.08	9.69 ± 6.43	-0.70 ± 10.73	2.07 1.36-2.78
8	11.01	13.29 ± 6.78	-2.87 ± 11.07	2.21 1.59-2.82

Task 1 - emplace the HIPIR
Task 2 - remove and stow antenna protective covers
Task 3 - level HIPIR
Task 4 - align HIPIR to base piece
Task 5 - perform daily check on HIPIR
Task 6 - prepare the HIPIR for travel
Task 7 - secure antenna, vent covers and hoods
Task 8 - roll and secure all cables

4.1.4 Launcher-loader. The launcher tasks were affected by wearing MOPPIV protective clothing with a range from 1.0 to 2.1. The task of aligning the launcher to the HIPIR again had the maximum correction factors. For analytical purposes, these factors cannot be separated from the HIPIR interplay. Because the alignment required actions between end items, the increase in time for the launcher might be accredited to the fact that the HIPIR was having difficulties. These interactions can not be determined from these data. Task 3, missile removal, and task 7, the lock to the launch pad, required significant correction factors (2.0 and 2.9, respectively) which were not observed in the Yuma trials. The results of the regression analysis for the launder-loader end item can be found in Table 19.

4.1.5 PAR. For the PAR, the correction factors ranged 1.0 to 2.2, which is on the same order as the other end items. The maximum degradation was seen in leveling the end item. The tasks of erecting and disassembling the antenna components were performed without error or injury, and with moderate degradation due to MOPPIV protective clothing. Table 20 reports the results of the regression analysis for the PAR end item. The analysis for task 5, energizing the PAR, was performed using only the data from 5 August through the first iteration of 7 August because of an equipment failure not related to MOPP conditions.

4.2 Regression results for the AFU. The times for performing unit tasks were also recorded at the PCP by the trained observer at that item. These times are a measure of the efficiency of the AFU to set up and prepare to fire a missile. The results show that the times to make the Fire Section operational and to march order the AFU have a correction factor of 1.4, which is approximately the same as that obtained during the Yuma trials.[4] Although the individual tasks have higher correction factor than those of the Yuma trials, the unit correction factors are not seriously affected. The results of the regression analysis for the AFU can be found in Table 21.

4.3 Survey questions. At the conclusion of each day of testing in MOPPIV clothing, each trial participant was requested to fill in a questionnaire about the problems encountered because of the MOPPIV clothing. There were 10 categories and each participant was requested to rate the clothing encumbrance as either none, minor, average, or major. These data were converted to numerical values by assigning numbers to the various ratings. The values were 0, 5, 10, and 15 for the none, minor, average, and major categories, respectively. The results of these data are shown in Table 22. On the overall, the test personnel for this series of trials at Cherry Point rated the MOPPIV gear approximately the same as those at the Yuma trials despite the very high humidity. As in the Yuma trials, the two biggest concerns among those questioned was the perceived heat buildup in the overgarment and the perspiration buildup in the mask.

TABLE 19. Regression Analysis - Launcher - Loader.

Task	Unencumbered term, T_o	Clothing correction, a	Training correction, b	MOPPIV CF/Range
1	11.64	2.42 ± 2.41	1.14 ± 4.10	1.21 1.00-1.41
2	11.64	2.42 ± 2.42	1.42 ± 4.10	1.21 1.00-1.42
3	5.16	1.09 ± 0.76	3.05 ± 1.28	1.21 1.06-1.36
4	10.01	10.78 ± 6.25	9.27 ± 10.62	2.08 1.45-2.70
5	0.72	0.34 ± 0.33	0.59 ± 0.56	1.47 1.01-1.93
6	3.74	-0.57 ± 0.63	4.61 ± 1.06	1.0(0.85)* 0.68-1.02
7	0.17	0.33 ± 0.29	1.81 ± 0.50	2.94 1.18-4.69
8	3.28	0.65 ± 1.01	6.65 ± 1.71	1.20 0.89-1.51
9	0.36	0.0 ± 0.05	0.04 ± 0.10	1.00 0.86-1.14
10	13.89	7.95 ± 6.02	-0.09 ± 9.94	1.57 1.14-2.01
11	8.55	0.19 ± 1.17	5.99 ± 1.94	1.02 0.89-1.16
12	11.18	2.73 ± 1.36	± 5.70 ± 2.27	1.24 1.12-1.37

Task 1 - emplace launcher
Task 2 - level launcher
Task 3 - remove missile from truck mounted storage pallet
Task 4 - align the launcher to the HIPIR
Task 5 - launcher preload check
Task 6 - transfer missile onto launcher
Task 7 - lock missile to launcher
Task 8 - perform SATO checks on missile
Task 9 - arm the missile
Task 10 - position launcher boom for unloading
Task 11 - transfer missiles from launcher to pallet
Task 12 - prepare the launcher for travel

* (calculated value), probably not degraded.

TABLE 20. Regression Analysis - PAR.

Task	Unencumbered term, T_o	Clothing correction, a	Training correction, b	MOPPIV CF/range
1	11.98	4.92 ± 2.13	13.27 ± 3.63	1.41 1.23-1.59
2	4.93	5.90 ± 1.93	4.78 ± 3.29	2.20 1.81-2.59
3	4.18	3.50 ± 2.09	± 10.89 ± 3.55	1.84 1.34-2.34
4	2.45	0.09 ± 0.50	2.19 ± 0.86	1.04 0.83-1.24
5	1.14	-0.27 ± 0.57	-0.12 ± 0.98	1.0(0.76)* 0.26-1.26
6	9.87	4.76 ± 1.47	7.59 ± 2.45	1.48 1.33-1.63
7	9.14	4.20 ± 1.53	6.32 ± 2.55	1.46 1.29-1.63
8	3.59	0.93 ± 0.87	3.66 ± 1.42	1.26 1.02-1.50

Task 1 - emplace PAR
Task 2 - level PAR
Task 3 - assemble antenna reflector
Task 4 - install antenna reflector
Task 5 - energize PAR
Task 6 - prepare PAR for travel
Task 7 - disassemble and stow omnidirectional antenna
Task 8 - disassemble and stow antenna reflector

* (calculated value), probably not degraded.

TABLE 21. Hawk Missile Unit Regression Data.

Unit Task	Intercept to	Gear, a	Order, b	MOPPIV CF
Emplace				
CWAR	11.24	1.80 ± 2.28	1.56 ± 3.58	1.2 1.0-1.4
LAUNCHER	11.32	2.91 ± 2.63	2.73 ± 4.44	1.3 1.0-1.5
HIPIR	5.98	1.20 ± 1.27	0.22 ± 2.11	1.2 1.0-1.4
IFF remoted	10.54	0.76 ± 1.99	18.95 ± 3.39	1.1 0.9-1.3
Linked to PCP	10.48	7.20 ± 3.13	9.19 ± 5.32	1.7 1.4-2.0
Orientation and alignment complete	25.00	15.94 ± 5.47	61.06 ± 14.94	1.6 1.4-1.9
ISC complete	45.00	18.75 ± 7.74	80.25 ± 20.89	1.4 1.2-1.6
Missile transfer				
to launcher	26.85	12.25 ± 6.81	22.98 ± 11.58	1.5 1.2-1.7
to pallet	56.66	17.92 ± 12.07	43.49 ± 20.15	1.3 1.1-1.5
Dailys complete				
CWAR	13.34	9.10 ± 3.75	18.59 ± 6.37	1.7 1.4-2.0
HIPIR	21.03	12.61 ± 7.26	44.56 ± 12.34	1.6 1.3-1.9
March ordered				
CWAR	69.09	22.71 ± 11.21	61.77 ± 18.71	1.3 1.2-1.5
PCP and IFF	72.87	21.72 ± 11.48	60.65 ± 19.16	1.3 1.1-1.5
LAUNCHER	71.43	19.75 ± 10.57	55.41 ± 17.64	1.3 1.1-1.4
PAR	69.22	21.87 ± 10.94	62.20 ± 18.26	1.3 1.2-1.5
HIPIR	72.93	22.69 ± 11.52	59.95 ± 19.23	1.3 1.2-1.5
AFU operational	47.64	17.26 ± 8.10	90.73 ± 16.09	1.4 1.2-1.5
Unit march ordered	73.48	26.66 ± 11.14	52.74 ± 18.59	1.4 1.2-1.5

TABLE 22. MOPPIV Personnel Survey Results.

Personnel Evaluation of MOPPIV Gear Encumbrances, Assault Fighting Unit

Factor	AFU-A MOPP trial 1	AFU-A MOPP trial 2	AFU-A Av	AFU-B MOPP trial 1	AFU-B MOPP trial 2	AFU-B Av	AFU-C MOPP trial 1	AFU-C MOPP trial 2	AFU-C Av	Overall Average
Mask/vision	6.9	7.8	7.4	7.2	6.0	6.6	7.9	8.9	8.4	7.5
Mask/water buildup	13.7	13.0	13.3	11.4	11.5	11.4	12.0	13.0	12.5	12.4
Mask/breathing	9.0	8.6	8.8	8.9	9.2	9.0	10.6	9.4	10.0	9.3
Mask/commo	8.5	8.2	8.3	9.4	9.0	9.2	6.5	6.9	6.7	8.1
Boots/movement	6.5	6.8	6.7	6.7	8.1	7.4	6.2	6.3	6.2	6.8
Boots/slipping	5.6	6.0	5.8	4.8	7.1	5.6	5.2	5.9	5.6	5.8
Gloves/operating equipment	5.6	5.8	5.7	5.6	5.6	5.6	6.5	7.0	6.8	6.0
Gloves/tasks	5.8	6.0	5.9	5.4	6.2	5.8	7.5	8.0	7.7	6.5
Overgarment/ bulkiness	9.0	7.1	8.1	9.4	10.6	10.0	10.2	10.2	10.2	9.5
Overgarment/ heat	13.5	13.2	13.3	13.7	13.3	13.5	15.0	14.1	14.5	13.8
AVERAGE	8.4	8.3	8.3	8.3	8.7	8.5	8.8	9.0	8.9	8.6

Rating:

0 - no degradation
5 - minor degradation
10 - average degradation
15 - major degradation

5. SUMMARY AND CONCLUSIONS

The degradation of personnel equipped in MOPPIV protective clothing has been quantified for a HAWK AFU. The inverse of the degradation is the correction factor which is reported for the individual components of the AFU in Table 23. It should be noted that results for the individual subtasks of each component were presented in Tables 16-20. Also shown in Table 23 is the probable range of the correction factor. These factors, when multiplied by the time to perform the task in BDU, provide a time estimate and the most probable range of times for performing similar tasks in MOPPIV clothing. These results show a moderate personnel degradation caused by clothing. During the trials, off-line tasks such as generator maintenance and operation were performed by personnel in BDU and are not rated in these trials.

TABLE 23. MOPPIV Correction Factors for Unit Tasks.

Task	Factor	Probable range
Emplace		
CWAR	1.2	1.0-1.4
LAUNCHER	1.3	1.0-1.5
HIPIR	1.2	1.0-1.4
IFF		
Remoted	1.1	0.9-1.3
Linked to PCP	1.7	1.4-2.0
Orientation and alignment complete	1.6	1.4-1.9
ISC complete	1.4	1.2-1.6
Missile transfer		
to launcher	1.5	1.2-1.7
to pallet	1.3	1.1-1.5
Dailys complete		
CWAR	1.7	1.4-2.0
HIPIR	1.6	1.3-1.9
March ordered		
CWAR	1.3	1.2-1.5
PCP and IFF	1.3	1.1-1.5
LAUNCHER	1.3	1.1-1.4
PAR	1.3	1.2-1.5
HIPIR	1.3	1.2-1.5
AFU operational	1.4	1.2-1.5
Unit march ordered	1.4	1.2-1.5

6. REFERENCES

1. Klopcic, J.T., and Roach, L.K. "An Introduction to the Use of the Army Unit Resiliency Analysis (AURA) Methodology: Volume I," US Army Ballistic Research Laboratory, Aberdeen Proving Ground, MD, Memorandum Report No. 3384, September 1984, UNCLASSIFIED.

2. Wick, C.H. "Performance Estimates for Operations Conducted While Wearing Individual Protective Equipment, User Manual, US Army Ballistic Research Laboratory, Aberdeen Proving Ground, MD, Memorandum Report No. 3647, January 1988, UNCLASSIFIED.

3. Morrissey, J.A., and Wick, C.H. "Degradation of HAWK Assault Fire Unit (AFU) Operating in a Chemical Environment, US Army Ballistic Research Laboratory, Aberdeen Proving Ground, MD, Technical Report, October 1989, UNCLASSIFIED.

4. Wick, C.H., Morrissey, J.A., and Klopcic, J.T. "Maintenance Operations in Mission Oriented Protective Posture Level IV, US Army Ballistic Research Laboratory, Aberdeen Proving Ground, MD, Memorandum Report No. 3629, October 1987, UNCLASSIFIED.

APPENDIX A:

ENVIRONMENTAL DATA

TABLE A-1. Cherry Point, Weather Data.

Date	Low Temp			High Temp			Average	
	Temp °F	%RH	Time	Temp °F	%RH	Time	Temp °F	%RH
5 Aug 85	71.6	76.8	0600	91.9	57.2	0900	83.5	61
6 Aug 85	70.5	97.1	0600	86.5	73.9	1300	80.4	81
7 Aug 85	70.7	103.0	0700	102.4	55.5	1000	90.5	62
8 Aug 85	75.0	94.7	0600	111.2	47.8	1000	87.4	79
9 Aug 85	72.9	107.6	0600	94.1	54.2	1300	8[illegible].7	87
12 Aug 85	71.2	107.7	0700	94.5	45.5	1300	83.7	76
13 Aug 85	71.8	109.0	0600	94.1	52.2	1300	84.2	75
14 Aug 85	72.9	97.4	0700	92.7	51.0	1300	81.9	77
15 Aug 85	72.5	89.0	0700	92.8	47.3	1300	82.0	67

Appendix A contains the daily field data collected during the MOPP degradation trials conducted at Cherry Point Marine Corps Air Station during the period 5 August 1985 through 15 August 1985.

APPENDIX B:

FIELD DATA FOR INDIVIDUAL COMPONENTS

This appendix contains the recorded times for the individual tasks for each component of the AFU.

TABLE B-1. 5 August 1985--BDU Uniform, PCP Time Data.

Task	Subtask	Iteration number 1A-1B	1A-2B	1A-3B
		Time, minutes		
Emplace PCP		3.5	4.3	3.1
	Ground PCP	4.1	2.0	0.6
	Lay cables	21.6	23.9	15.4
Emplace IFF		41.1*	15.6	7.3
Align IFF to base unit		40.1*	12.0	18.9
Perform daily checks		8.9	3.4	1.8
Perform daily IFF checks		34.2	2.7	4.2
March order PCP		17.1	15.8	12.0
	Stow IFF	17.1	12.4	12.0
	Secure	13.6	9.6	4.4

* Data not used in regression analysis because of equipment problem not MOPP related.

TABLE B-2. 5 August 1985--BDU Uniform, CWAR Time Data.

Task	Subtask	Iteration number 1A-1B	1A-2B	1A-3B
		Time, minutes		
Emplace CWAR		13.7	8.1	9.4
	Ground CWAR	2.9	1.5	3.3
	Level CWAR	13.7	8.1	9.4
Energize CWAR		0.2	0.7	0.1
Perform dailys		6.9	8.4	9.0
Align CWAR		21.0	9.0	10.0
March order CWAR		11.9	8.4	7.9
	Secure antenna cover	7.2	2.0	2.9
	Secure cables	11.9	8.4	7.9

TABLE B-3. 5 August 1985--BDU Uniform, HIPIR Time Data.

Task	Subtask	Iteration number 1A-1B	1A-2B	1A-3B
		Time, minutes		
Emplace HIPIR		3.6	2.4	2.1
	Stow antenna covers	1.7	1.1	5.1
	Level HIPIR	13.0	13.1	10.7
Align HIPIR		12.6	3.0	3.7
Perform dailys		5.9	13.1	15.9
March order HIPIR		14.0	12.2	7.7
	Stow antenna secure vent covers	14.0	9.0	7.7
	Roll and secure cables	11.4	12.2	0.0

TABLE B-4. 5 August 1985--BDU Uniform, PAR Time Data.

Task	Subtask	Iteration number 1A-1B	1A-2B	1A-3B
		Time, minutes		
Emplace PAR		29.3	22.7	17.0
	Level PAR	4.0	6.6	11.2
	Assemble antenna reflector	29.3	22.7	12.6
Install antenna reflector		2.0	3.3	4.4
Energize PAR		1.7	5.8	5.4
March order PAR		20.9	15.1	14.6
	Stow omni-directional antenna	20.9	14.5	14.2
	Stow antenna reflector	9.4	4.3	3.4

TABLE B-5. 5 August 1985--BDU Uniform, LAUNCHER Time Data.

Task	Subtask	Iteration number 1A-1B	1A-2B	1A-3B
		Time, minutes		
Emplace LCHR		16.5	17.7	12.3
	Level LCHR	16.5	17.7	12.3
Unload missile	from pallet	8.2	5.5	5.2
Align LCHR		4.8	4.9	0.8
Preload checks		2.5	2.0	0.4
Transfer missile	onto LCHR	10.5	4.8	2.8
Lock missile	to LCHR	0.2	0.4	0.3
Perform SATO checks		15.5	4.9	4.3
Arm missile		0.5	0.4	0.3
Position LCHR boom	for unloading	0.3	0.6	43.9
Transfer missile	to pallet	19.5	10.1	9.6
March order LCHR		17.9	18.5	12.6

TABLE B-6. 5 August 1985--MOPP IV Uniform, PCP Time Data.

Task	Subtask	Iteration number 2A-1M	2A-2M	2A-3M	2A-4M
		Time, minutes			
Emplace PCP		3.7	6.1	8.8	5.5
	Ground PCP	1.3	1.9	10.8	2.6
	Lay cables	12.8	20.1	19.5	20.4
Emplace IFF		9.8	5.0	8.4	4.9
Align IFF to base unit		25.9	14.6	5.3	14.7
Perform daily checks		11.8	11.7	5.3	11.3
Perform daily IFF checks		1.8	9.0	7.1	1.1
March ordered PCP		15.3	15.3	13.4	13.5
	Stow IFF	10.4	9.6	8.8	9.5
	Secure	13.3	11.7	11.3	11.7

TABLE B-7. 5 August 1985--MOPP IV Uniform, CWAR Time Data.

Task	Subtask	Iteration number 2A-1M	2A-2M	2A-3M	2A-4M
		Time, minutes			
Emplace CWAR		13.0	9.5	10.1	12.9
	Ground CWAR	3.8	2.8	2.0	2.0
	Level CWAR	13.0	9.5	10.1	12.9
Energize CWAR		5.3	4.9	4.4	4.9
Perform dailys		2.6	2.3	2.5	2.3
Align CWAR		23.0	14.6	12.9	10.0
March ordered CWAR		8.0	8.3	6.7	7.3
	Secure antenna cover	1.9	2.5	2.9	2.1
	Secure cables	8.0	8.3	6.7	7.3

TABLE B-8. 5 August 1985--MOPP IV Uniform, HIPIR Time Data.

Task	Subtask	Iteration number 2A-1M	2A-2M	2A-3M	2A-4M
		Time, minutes			
Emplace HIPIR		3.8	8.0	3.5	4.3
	Stow antenna covers	5.9	5.5	8.7	7.3
	Level HIPIR	7.6	10.1	10.3	8.5
Align HIPIR		12.1	6.2	19.0	10.8
Perform dailys		6.8	10.2	7.4	11.9
March ordered HIPIR		18.0	15.3	16.6	16.8
	Stow antenna	10.8	9.4	8.0	8.2
	Secure vent covers	18.0	15.3	16.6	16.8

TABLE B-9. 5 August 1985--MOPP IV Uniform, PAR Time Data.

Task	Subtask	Iteration number 2A-1M	2A-2M	2A-3M	2A-4M
		Time, minutes			
Emplace PAR		32.9	21.5	15.5	16.4
	Level PAR	32.3	7.2	14.6	12.4
	Assemble antenna reflector	25.5	18.1	12.7	14.6
Install antenna reflector		3.9	2.9	2.1	1.5
Energize PAR		4.0	3.6	0.5	1.3
March order PAR		20.8	21.2	16.7	12.0
	Stow omni-directional antenna	20.8	20.7	16.4	12.0
	Stow antenna reflector	9.0	10.0	6.4	2.3

TABLE B-10. 5 August 1985--MOPP IV Uniform, LAUNCHER Time Data.

Task	Subtask	Iteration number 2A-1M	2A-2M	2A-3M	2A-4M
		Time, minutes			
Emplace LCHR		12.6	12.4	15.3	11.9
	Level LCHR	12.6	12.4	15.3	11.9
Unload missile	from pallet	8.2	5.6	5.4	5.4
Align LCHR		5.7	3.3	2.8	3.2
Preload checks		0.6	0.4	0.5	0.3
Transfer missile	onto LCHR	3.6	3.3	2.8	2.6
Lock missile	to LCHR	0.5	0.4	0.2	0.2
Perform SATO checks		7.1	4.6	4.2	3.8
Arm missile		0.6	0.3	0.3	0.3
Position LCHR boom	for unloading	36.4	41.4	21.0	29.9
Transfer missile	to pallet	12.4	9.8	11.4	7.6
March order LCHR		18.0	11.2	12.7	12.9

TABLE B-11. 5 August 1985--MOPP IV Uniform, PCP Time Data.

Task	Subtask	Iteration number 3A-1ML	3A-2ML	3A-3ML	3A-4ML
		Time, minutes			
Emplace PCP		2.5	9.6	8.6	4.8
	Ground PCP	0.4	2.6	2.4	12.3
	Lay cables	17.1	13.7	16.6	14.1
Emplace IFF		5.6	7.5	5.4	6.5
Align IFF to base unit		4.5	6.9	18.2	9.4
Perform daily checks		7.6	6.2	5.0	2.7
Perform daily IFF checks		1.3	2.3	1.9	9.5
March order PCP		13.2	12.5	13.3	9.3
	Stow IFF	13.2	10.6	11.2	7.0
	Secure	9.0	9.3	11.3	4.2

TABLE B-12. 7 August 1985--MOPP IV Uniform, CWAR Time Data.

Task	Subtask	Iteration number 3A-1ML	3A-2ML	3A-3ML	3A-4ML
		Time, minutes			
Emplace CWAR		14.8	9.1	10.3	9.3
	Ground CWAR	5.2	2.2	2.3	1.9
	Level CWAR	14.8	9.1	10.2	9.3
Energize CWAR		5.1	4.8	4.9	4.0
Perform dailys		14.9	2.7	2.4	2.0
Align CWAR		3.9	11.9	15.7	7.1
March order CWAR		8.3	6.5	7.6	7.1
	Secure antenna cover	3.3	2.8	3.0	1.8
	Secure cables	8.3	6.5	7.6	7.1

TABLE B-13. 7 August 1985--MOPP IV Uniform, HIPIR Time Data.

Task	Subtask	Iteration number 3A-1ML	3A-2ML	3A-3ML	3A-4ML
		Time, minutes			
Emplace HIPIR		3.9	5.2	2.4	2.7
	Stow antenna covers	4.5	0.9	5.0	8.4
	Level HIPIR	9.0	17.3	9.9	10.4
Align HIPIR		11.4	4.6	17.0	4.6
Perform dailys		4.1	5.1	10.0	10.0
March order HIPIR		13.6	13.9	15.8	19.9
	Stow antenna	9.6	7.9	10.8	12.0
	Secure vent covers	13.6	13.9	15.8	19.9

TABLE B-14. 7 August 1985--MOPP IV Uniform, PAR Time Data.

Task	Subtask	Iteration number 3A-1ML	3A-2ML	3A-3ML	3A-4ML
		Time, minutes			
Emplace PAR		22.8	19.9	16.9	21.8
	Level PAR	8.8	9.8	6.6	7.6
	Assemble antenna reflector	18.7	18.2	16.9	21.8
Install antenna reflector		4.0	1.3	1.9	3.8
Energize PAR		3.9	0.3[a]	0.9[a]	0.2[a]
March order PAR		20.4	18.8	16.8	10.2
	Stow omni-directional antenna	-39.6	14.1	14.9	9.5
	Stow antenna reflector	4.2	8.8	5.0	1.0

[a] Data not used in regression analysis because of equipment problem not MOPP related.

TABLE B-15. 7 August 1985--MOPP IV Uniform, LAUNCHER Time Data.

Task	Subtask	Iteration number 3A-1ML	3A-2ML	3A-3ML	3A-4ML
		Time, minutes			
Emplace LCHR		12.4	15.8	13.4	9.4
	Level LCHR	12.4	15.8	13.4	9.4
Unload missile	from pallet	6.2	6.6	5.3	4.2
Align LCHR		2.9	3.8	2.1	17.3
Preload checks		0.5	0.7	0.2	0.5
Transfer missile	onto LCHR	2.9	2.3	1.7	2.2
Lock missile	to LCHR	0.3	0.9	0.3	0.5
Perform SATO checks		3.2	4.2	2.6	1.7
Arm missile		0.3	0.5	0.3	0.3
Position LCHR	for unloading	19.1	10.9	19.7	0.0
Transfer missile	to pallet	8.6	10.1	9.8	5.5
March order LCHR		15.2	14.0	12.3	11.3

TABLE B-16. 8 August 1985--MOPP IV Uniform, PCP Time Data.

Task	Subtask	Iteration number 3A-1M Time, minutes	3A-2M Time, minutes
Emplace PCP		2.7	4.9
	Ground PCP	0.4	0.6
	Lay cables	25.6	55.1
Emplace IFF		5.8	6.3
Align IFF to base unit		28.3	62.2
Perform daily checks		19.5	2.0
Perform daily IFF checks		18.2	20.9
March order PCP		23.6	*
	Stow IFF	14.0	*
	Secure	20.9	*

* Trial 1B-2M was stopped for a lunch break at approximately noon. After the break, the trial could not be continued because of rain; the trial was terminated after the AFU was operational.

TABLE B-17. 8 August 1985--MOPP IV Uniform, CWAR Time Data.

Task	Subtask	Iteration number 1B-1M	1B-2M
		Time, minutes	
Emplace CWAR		11.3	14.3
	Ground CWAR	5.3	0.5
	Level CWAR	11.3	14.3
Energize CWAR		5.3	4.3
Perform dailys		20.5	38.8
Align CWAR		31.8	19.8
March order CWAR		15.8	*
	Secure antenna cover	6.9	*
	Secure cables	15.8	*

* Trial 1B-2M was stopped for a lunch break at approximately noon. After the break, the trial could not be continued because of rain; the trial was terminated after the AFU was operational.

TABLE B-18. 8 August 1985--MOPP IV Uniform, HIPIR Time Data.

Task	Subtask	Iteration number 1B-1M	1B-2M
		Time, minutes	
Emplace HIPIR		7.5	7.7
	Stow antenna covers	25.2	10.7
	Level HIPIR	11.7	20.3
Align HIPIR		56.6	44.3
Perform dailys		68.6	8.4
March order HIPIR		24.6	*
	Stow antenna	20.5	*
	Secure vent covers	24.6	*

* Trial 1B-2M was stopped for a lunch break at approximately noon. After the break, the trial could not be continued because of rain; the trial was terminated after the AFU was operational.

TABLE B-19. 8 August 1985--MOPP IV Uniform, PAR Time Data.

Task	Subtask	Iteration number 1B-1M	1B-2M
		Time, minutes	
Emplace PAR		32.8	24.0
	Level PAR	11.3	8.5
	Assemble antenna reflector	28.0	21.8
Install antenna reflector		4.7	2.1
Energize PAR		0.5[a]	0.3[a]
March order PAR		22.6	[b]
	Stow omni-directional antenna	15.5	[b]
	Stow antenna reflector	6.0	[b]

[a] Data not used in regression analysis because of equipment problem not MOPP related.

[b] Trial 1B-2M was stopped for a lunch break at approximately noon. After the break, the trial could not be continued because of rain; the trial was terminated after the AFU was operational.

TABLE B-20. 8 August 1985--MOPP IV Uniform, LAUNCHER Time Data.

Task	Subtask	Iteration number 1B-1M Time, minutes	1B-2M Time, minutes
Emplace LCHR		16.8	15.7
	Level LCHR	16.8	15.7
Unload missile	from pallet	10.8	6.1
Align LCHR		67.2	64.8
Preload checks		1.3	0.1
Transfer missile	onto LCHR	6.8	8.1
Lock missile	to LCHR	0.5	0.4
Perform SATO checks		14.9	6.2
Arm missile		0.4	0.3
Position LCHR boom	for unloading	56.9	*
Transfer missile	to pallet	13.3	*
March order LCHR		18.5	*

* Trial 1B-2M was stopped for a lunch break at approximately noon. After the break, the trial could not be continued because of rain; the trial was terminated after the AFU was operational.

TABLE B-21. 9 August 1985--BDU Uniform, PCP Time Data.

Task	Subtask	Iteration number 2B-1B	2B-2B	2B-3B	2B-4B	2B-5B
		Time, minutes				
Emplace PCP		4.7	4.7	2.7	4.1	3.5
	Ground PCP	0.4	1.5	0.7	1.0	0.4
	Lay cables	16.1	12.0	10.7	9.6	9.5
Emplace IFF		4.7	4.4	3.6	7.9	5.9
Align IFF to base unit		21.4	21.1	16.7	7.6	8.2
Perform daily checks		2.9	4.2	7.9	6.0	7.4
Perform daily IFF checks		1.8	2.6	2.1	3.3	3.4
March order PCP		18.5	13.8	11.6	13.2	12.3
	Stow IFF	13.2	9.7	7.2	11.0	7.3
	Secure	15.7	12.8	10.6	13.2	12.3

TABLE B-22. 9 August 1985--BDU Uniform, CWAR Time Data.

Task	Subtask	Iteration number 2B-1B	2B-2B	2B-3B	2B-4B	2B-5B
		Time, minutes				
Emplace CWAR		8.2	6.9	5.7	6.2	5.2
	Ground CWAR	1.5	0.4	0.3	0.5	0.5
	Level CWAR	8.2	6.9	5.7	6.2	5.2
Energize CWAR		5.3	3.5	4.8	4.4	4.8
Perform dailys		1.7	2.6	1.7	2.1	1.3
Align CWAR		17.9	13.5	12.8	9.5	13.1
March order CWAR		8.8	8.5	7.7	8.8	6.1
	Secure antenna cover	8.2	4.6	5.4	2.3	1.9
	Secure cables	8.8	8.5	7.7	8.8	6.1

TABLE B-23. 9 August 1985--BDU Uniform, HIPIR Time Data.

Task	Subtask	Iteration number 2B-1B	2B-2B	2B-3B	2B-4B	2B-5B
		Time, minutes				
Emplace HIPIR		5.4	6.7	6.3	7.0	5.0
	Stow antenna covers	10.2	8.7	8.8	11.4	6.9
	Level HIPIR	11.9	11.6	12.2	13.4	14.0
Align HIPIR		6.2	10.0	16.0	10.0	11.5
Perform dailys		4.8	5.1	5.0	7.4	10.0
March order HIPIR		18.0	15.0	14.7	14.2	12.3
	Stow antenna	14.0	14.0	11.7	9.0	8.3
	Secure vent covers	18.0	15.0	14.7	14.2	8.3

TABLE B-24. 9 August 1985--BDU Uniform, PAR Time Data.

Task	Subtask	Iteration number 2B-1B	2B-2B	2B-3B	2B-4B	2B-5B
		Time, minutes				
Emplace PAR		15.3	12.8	14.0	10.6	14.4
	Level PAR	4.4	3.3	2.8	2.0	4.4
	Assemble antenna reflector	13.5	11.9	14.0	9.9	14.0
Install antenna reflector		1.7	2.4	2.7	5.2	5.2
Energize PAR		0.3[a]	0.2[a]	0.3[a]	0.1[a]	0.1[a]
March order PAR		11.5	12.2	11.0	9.3	12.0
	Stow omni-directional antenna	11.5	9.3	9.0	9.0	9.9
	Stow antenna reflector	0.5	3.8	5.1	4.9	5.3

[a] Data not used in regression analysis because of equipment problem not MOPP related.

TABLE B-25. 9 August 1985--MOPP IV Uniform, LAUNCHER Time Data.

Task	Subtask	Iteration number 2B-1B	2B-2B	2B-3B	2B-4B	2B-5B
		Time, minutes				
Emplace LCHR		12.1	6.4	9.7	9.9	38.8
	Level LCHR	12.1	6.4	9.7	9.9	38.8
Unload missile	from pallet	6.5	11.8	5.1	5.8	7.0
Align LCHR		22.1	12.2	13.3	13.6	0.2
Preload checks		1.2	0.5	0.2	0.5	0.3
Transfer missile	onto LCHR	5.9	7.8	3.9	2.6	4.6
Lock missile	to LCHR	0.4	0.3	0.3	0.3	0.3
Perform SATO checks		1.0	0.6	2.4	2.6	2.0
Arm missile		0.7	0.2	0.4	0.5	0.2
Position LCHR boom	for unloading	9.5	16.8	19.6	6.8	3.3
Transfer missile	to pallet	13.8	13.7	6.0	9.4	13.7
March order LCHR		15.2	9.5	12.7	11.3	11.4

TABLE B-26. 12 August 1985--MOPP IV Uniform, PCP Time Data.

Task	Subtask	Iteration number 3B-1ML	3B-2ML	3B-3ML
		Time, minutes		
Emplace PCP		9.6	6.0	6.2
	Ground PCP	0.3	1.8	2.7
	Lay cables	24.1	0.0	13.4
Emplace IFF		9.0	6.8	6.1
Align IFF to base unit		21.4	16.9	12.7
Perform daily checks		19.1	22.4	6.5
Perform daily IFF checks		2.8	*	1.6
March order PCP		13.9	16.7	15.1
	Stow IFF	13.4	-72.9	12.5
	Secure	10.2	-72.9	15.1

* no data

TABLE B-27. 12 August 1985--MOPP IV Uniform, CWAR Time Data.

Task	Subtask	Iteration number 3B-1ML	3B-2ML	3B-3ML
		Time, minutes		
Emplace CWAR		7.1	8.4	7.1
	Ground CWAR	0.7	0.8	0.3
	Level CWAR	7.1	8.4	7.1
Energize CWAR		5.3	6.5	4.6
Perform dailys		4.1	1.2	-8.6
Align CWAR		20.3	19.2	19.3
March order CWAR		12.6	10.1	10.4
	Secure antenna cover	7.2	6.0	5.1
	Secure cables	12.6	10.1	10.4

TABLE B-28. 12 August 1985--MOPP IV Uniform, HIPIR Time Data.

Task	Subtask	Iteration number 3B-1ML	3B-2ML	3B-3ML
		Time, minutes		
Emplace HIPIR		13.1	9.9	6.1
	Stow antenna covers	15.5	8.5	15.1
	Level HIPIR	24.8	14.6	14.2
Align HIPIR		8.9	9.7	28.0
Perform dailys		12.2	10.0	9.9
March order HIPIR		21.8	16.8	20.1
	Stow antenna	21.8	15.0	20.1
	Secure antenna covers	21.4	16.8	18.4

TABLE B-29. 12 August 1985--MOPP IV Uniform, PAR Time Data.

Task	Subtask	Iteration number 3B-1ML	3B-2ML	3B-3ML
		Time, minutes		
Emplace PAR		23.1	13.3	14.7
	Level PAR	11.7	3.0	3.9
	Assemble antenna reflector	23.1	13.3	14.7
Install antenna reflector		2.1	2.6	4.6
Energize PAR		0.2[a]	0.3[a]	0.1[a]
March order PAR		12.9	14.0	12.7
	Stow omni-directional antenna	12.1	9.3	9.7
	Stow antenna reflector	5.1	5.8	3.4

[a] Data not used in regression analysis because of equipment problem not MOPP related.

TABLE B-30. 12 August 1985--MOPP IV Uniform, LAUNCHER Time Data.

Task	Subtask	Iteration number 3B-1ML	3B-2ML	3B-3ML
		Time, minutes		
Emplace LCHR		29.5	15.5	11.0
	Level LCHR	29.5	15.5	11.0
Unload missile	from pallet	11.1	5.2	7.3
Align LCHR		12.2	17.2	19.7
Preload checks		0.4	0.5	0.7
Transfer missile	onto LCHR	4.1	3.3	4.3
Lock missile	to LCHR	0.3	0.4	0.3
Perform SATO checks		8.4	3.0	0.3
Arm missile		0.2	0.2	0.4
Position LCHR boom	for unloading	8.6	22.4	26.3
Transfer missile	to pallet	11.3	9.6	10.2
March order LCHR		11.1	8.0	6.8

TABLE B-31. 13 August 1985--MOPP IV Uniform, PCP Time Data.

Task	Subtask	Iteration number 1C-1M	1C-2M	1C-3M	1C-4M
		Time, minutes			
Emplace PCP		4.6	3.7	3.0	3.3
	Ground PCP	3.5	2.5	0.7	1.3
	Lay cables	32.6	12.9	19.7	23.8
Emplace IFF		29.3	6.8	9.3	7.4
Align IFF to base unit		*	*	36.3	20.2
Perform daily checks		*	*	6.3	12.7
Perform daily IFF checks		*	*	7.4	5.6
March order PCP		12.6	12.4	18.6	22.4
	Stow IFF	11.1	10.4	13.9	11.3
	Secure	12.4	12.1	12.7	22.3

* Because of a fire in the PCP at the start of trial 1C-1M, this task could not be completed. Alignment was also not possible because there was no communication.

TABLE B-32. 13 August 1985--MOPP IV Uniform, CWAR Time Data.

Task	Subtask	Iteration number 1C-1M	1C-2M	1C-3M	1C-4M
		Time, minutes			
Emplace CWAR		11.9	9.3	8.5	9.2
	Ground CWAR	0.6	0.7	1.1	2.0
	Level CWAR	11.9	9.3	8.5	9.2
Energize CWAR		31.6	5.1	4.9	4.0
Perform dailys		6.0	6.0	5.0	5.6
Align CWAR		*	*	42.8	25.9
March order CWAR		14.9	11.6	14.3	20.0
	Secure antenna cover	13.5	10.1	14.3	20.0
	Secure cables	14.9	11.6	10.7	18.2

* Because of a fire in the PCP at the start of trial 1C-1M, this task could not be completed. Alignment was also not possible because there was no communications.

TABLE B-33. 13 August 1985--MOPP IV Uniform, HIPIR Time Data.

Task	Subtask	Iteration number 1C-1M	1C-2M	1C-3M	1C-4M
		Time, minutes			
Emplace HIPIR		9.8	6.3	7.5	4.6
	Stow antenna covers	7.3	8.1	5.8	5.7
	Level HIPIR	15.5	12.8	7.5	7.1
Align HIPIR		*	4.2	12.9	2.6
Perform dailys		28.2	12.1	9.5	10.0
March order HIPIR		15.0	20.9	21.5	29.3
	Stow antenna	10.0	22.0	11.3	18.8
	Secure vent covers	15.0	20.9	21.5	29.3

* Because of a fire in the PCP at the start of trial 1C-1M, this task could not be completed. Alignment was also not possible because there was no communications.

TABLE B-34. 13 August 1985--MOPP IV Uniform, PAR Time Data.

Task	Subtask	Iteration number 1C-1M	1C-2M	1C-3M	1C-4M
		Time, minutes			
Emplace PAR		23.5	12.8	11.6	10.5
	Level PAR	25.4	12.8	10.8	9.7
	Assemble antenna reflector	15.9	10.0	9.5	8.8
Install antenna reflector		7.4	2.2	1.9	1.6
Energize PAR		0.3*	0.1*	0.1*	0.2*
March order PAR		18.4	11.9	10.2	19.4
	Stow omni-directional antenna	18.4	11.9	9.9	19.4
	Stow antenna reflector	8.2	3.2	2.5	1.6

* Data not used in regression analysis because of equipment problem not MOPP related.

TABLE B-35. 13 August 1985--MOPP IV Uniform, LAUNCHER.

Task	Subtask	Iteration number 1C-1M	1C-2M	1C-3M	1C-4M
		Time, minutes			
Emplace LCHR		10.7	17.2	10.4	11.4
	Level LCHR	10.7	17.2	10.4	11.4
Unload missile	from pallet	7.8	8.7	6.3	5.2
Align LCHR		7.4	18.2	51.6	33.9
Preload checks		0.2	1.7	0.0	0.8
Transfer missile	onto LCHR	6.6	5.8	2.4	2.7
Lock missile	to LCHR	5.9	0.5	0.3	0.1
Perform SATO checks		0.7	5.8	6.1	4.9
Arm missile		0.3	0.5	0.5	0.6
Position LCHR boom	for unloading	0.1	0.3	3.6	3.0
Transfer missile	to pallet	11.3	10.3	7.8	6.2
March order LCHR		19.7	19.7	21.4	17.1

TABLE B-36. 14 August 1985--MOPP IV Uniform, PCP Time Data.

Task	Subtask	Iteration number 2C-1ML	2C-2ML	2C-3ML
		Time, minutes		
Emplace PCP		4.3	5.0	4.9
	Ground PCP	4.7	3.8	3.5
	Lay cables	21.4	[a]	14.3
Emplace IFF		9.0	10.1	8.1
Align IFF to base unit		7.5	43.6	26.4
Perform daily checks		6.7	5.3	6.3
Perform daily IFF checks		22.3	1.3	1.4
March order PCP		27.9	16.1	[b]
	Stow IFF	22.9	-45.9	[b]
	Secure	20.9	-46.6	[b]

[a] No data.

[b] Trial 2C-3M was stopped for lunch break and not continued in the afternoon because a RED flag condition existed with humidity and temperature.

TABLE B-37. 14 August 1985--MOPP IV Uniform, CWAR Time Data.

Task	Subtask	Iteration number 2C-1ML	2C-2ML	2C-3ML
		Time, minutes		
Emplace CWAR		9.3	8.6	7.2
	Ground CWAR	0.7	0.9	2.5
	Level CWAR	9.3	8.6	7.2
Energize CWAR		7.5	8.5	11.7
Perform dailys		1.7	7.6	3.6
Align CWAR		27.9	35.9	15.7
March order CWAR		11.3	10.2	*
	Secure antenna cover	11.3	10.2	*
	Secure cables	9.1	10.2	*

* Trial 2C-3M was stopped for lunch break and not continued in the afternoon because a RED flag condition existed with humidity and temperature.

TABLE B-38. 14 August 1985--MOPP IV Uniform, HIPIR Time Data.

Task	Subtask	Iteration number 2C-1ML	2C-2ML	2C-3ML
		Time, minutes		
Emplace HIPIR		5.0	6.7	5.6
	Stow antenna covers	8.4	8.5	8.7
	Level HIPIR	9.7	10.0	9.0
Align HIPIR		35.4	56.3	20.9
Perform dailys		11.8	38.4	8.5
March order HIPIR		20.5	113.3	*
	Stow antenna	13.9	106.3	*
	Secure vent covers	20.5	113.3	*

* Trial 2C-3M was stopped for lunch break and not continued in the afternoon because a RED flag condition existed with humidity and temperature.

TABLE B-39. 14 August 1985--MOPP IV Uniform, PAR Time Data.

Task	Subtask	Iteration number 2C-1ML	2C-2ML	2C-3ML
		Time, minutes		
Emplace PAR		12.3	9.2	8.5
	Level PAR	12.8	9.2	7.7
	Assemble antenna reflector	8.9	7.0	7.9
Install antenna reflector		2.1	0.8	1.6
Energize PAR		0.1[a]	0.1[a]	0.1[a]
March order PAR		11.1	8.5	[b]
	Stow omni-directional antenna	9.7	8.3	[b]
	Stow antenna reflector	2.5	2.8	[b]

[a] Data not used in regression analysis because of equipment problem not MOPP related.

[b] Trial 2C-3M was stopped for lunch break and not continued in the afternoon because a RED flag condition existed with humidity and temperature.

TABLE B-40. 14 August 1985--MOPP IV Uniform, LAUNCHER Time Data.

Task	Subtask	Iteration number 2C-1ML	2C-2ML	2C-3ML
		Time, minutes		
Emplace LCHR		12.0	11.5	19.1
	Level LCHR	12.0	11.5	19.1
Unload missile	from pallet	7.2	5.0	3.5
Align LCHR		31.3	51.5	18.3
Preload checks		4.7	1.0	0.5
Transfer missile	onto LCHR	3.2	2.5	1.4
Lock missile	to LCHR	0.8	0.4	0.3
Perform SATO checks		4.1	2.8	3.3
Arm missile		0.3	0.4	0.3
Position LCHR boom	for unloading	42.7	28.8	*
Transfer missile	to pallet	6.8	6.4	*
March order LCHR		16.3	15.6	*

* Trial 2C-3M was stopped for lunch break and not continued in the afternoon because a RED flag condition existed with humidity and temperature.

TABLE B-41 15 August 1985--BDU Uniform, PCP Time Data.

Task	Subtask	Iteration number 3C-1B	3C-2B	3C-3B	3C-4B	3C-5B
		Time, minutes				
Emplace PCP		2.5	8.4	5.4	2.1	7.1
	Ground PCP	1.6	2.9	0.5	1.0	0.3
	Lay cables	11.9	7.7	7.7	5.9	4.8
Emplace IFF		9.3	5.0	6.0	5.7	4.8
Align IFF to base unit		14.4	6.2	6.1	4.7	3.7
Perform daily checks		15.6	5.7	4.4	4.4	4.6
Perform daily IFF checks		2.7	1.4	1.4	1.4	1.6
March order PCP		10.5	8.3	7.0	7.2	5.5
	Stow IFF	7.1	7.3	6.5	6.0	5.4
	Secure	8.0	6.8	4.9	5.2	4.1

TABLE B-42. 15 August 1985--BDU Uniform, CWAR Time Data.

Task	Subtask	Iteration number 3C-1B	3C-2B	3C-3B	3C-4B	3C-5B
		Time, minutes				
Emplace CWAR		8.5	6.5	4.3	4.5	4.9
	Ground CWAR	2.5	1.2	0.7	0.6	0.9
	Level CWAR	8.5	6.5	4.3	4.5	4.9
Energize CWAR		5.2	5.0	4.6	3.6	4.2
Perform dailys		3.2	2.7	2.7	1.5	1.3
Align CWAR		18.4	5.1	4.1	3.5	4.8
March order CWAR		7.7	6.6	4.7	5.1	4.4
	Secure antenna cover	7.7	3.1	2.3	2.7	2.1
	Secure cables	6.2	6.6	4.7	5.1	4.4

TABLE B-43. 15 August 1985--BDU Uniform, HIPIR Time Data.

Task	Subtask	Iteration number 3C-1B	3C-2B	3C-3B	3C-4B	3C-5B
		Time, minutes				
Emplace HIPIR		6.5	3.1	3.6	2.0	1.8
	Stow antenna covers	6.9	5.5	3.3	2.7	2.5
	Level HIPIR	8.7	6.0	3.7	3.0	2.7
Align HIPIR		19.3	0.2	0.1	5.8	8.8
Perform dailys		7.3	7.3	7.0	5.5	5.7
March order HIPIR		14.8	11.7	8.1	6.5	6.1
	Stow antenna	7.0	10.6	5.1	2.3	4.6
	Secure vent covers	7.0	11.7	8.1	2.5	6.1

TABLE B-44. 15 August 1985--BDU Uniform, PAR Time Data.

Task	Subtask	Iteration number 3C-1B	3C-2B	3C-3B	3C-4B	3C-5B
		Time, minutes				
Emplace PAR		7.5	8.6	5.4	5.0	6.4
	Level PAR	7.5	7.7	5.0	4.3	5.6
	Assemble antenna reflector	5.6	6.8	4.5	5.0	6.4
Install antenna reflector		1.4	1.6	0.7	1.1	2.3
Energize PAR		0.1*	0.3*	0.5*	0.4*	0.5*
March order PAR		8.0	6.7	5.0	4.5	5.1
	Stow omni-direction antenna	6.7	5.9	4.8	4.5	5.0
	Stow antenna reflector	2.8	2.6	1.2	1.6	1.3

* Data not used in regression analysis because of equipment problem not MOPP related.

TABLE B-45. 15 August 1985--BDU Uniform, LAUNCHER Time Data.

Task	Subtask	Iteration number 3C-1B	3C-2B	3C-3B	3C-4B	3C-5B
		Time, minutes				
Emplace LCHR		6.7	5.4	7.5	4.7	5.0
	Level LCHR	6.7	5.4	7.5	4.7	5.0
Unload missile	from pallet	4.5	3.0	3.0	2.2	2.3
Align LCHR		28.4	14.8	9.3	8.5	6.5
Preload checks		0.4	1.4	0.2	0.3	0.1
Transfer missile	onto LCHR	3.7	2.1	1.3	1.6	1.6
Lock missile	to LCHR	0.5	0.2	0.3	0.2	0.3
Perform SATO checks		4.7	3.3	3.9	2.6	1.5
Arm missile		0.2	0.2	0.2	0.7	0.2
Position LCHR boom	for unloading	48.1	12.9	9.8	4.4	4.5
Transfer missile	to pallet	3.1	4.8	5.4	4.7	3.5
March order LCHR		11.2	10.2	10.0	5.4	5.1

No of Copies	Organization
(Unclass., unlimited) 12	Administrator
(Unclass., limited) 2	Defense Technical Info Center
(Classified) 2	ATTN: DTIC-DDA
	Cameron Station
	Alexandria, VA 22304-6145
1	HQDA (SARD-TR)
	WASH DC 20310-0001
1	Commander
	US Army Materiel Command
	ATTN: AMCDRA-ST
	5001 Eisenhower Avenue
	Alexandria, VA 22333-0001
1	Commander
	US Army Laboratory Command
	ATTN: AMSLC-DL
	Adelphi, MD 20783-1145
2	Commander
	Armament RD&E Center
	US Army AMCCOM
	ATTN: SMCAR-MSI
	Picatinny Arsenal, NJ 07806-5000
2	Commander
	Armament RD&E Center
	US Army AMCCOM
	ATTN: SMCAR-TDC
	Picatinny Arsenal, NJ 07806-5000
1	Director
	Benet Weapons Laboratory
	Armament RD&E Center
	US Army AMCCOM
	ATTN: SMCAR-LCB-TL
	Watervliet, NY 12189-4050
1	Commander
	US Army Armament, Munitions
	and Chemical Command
	ATTN: SMCAR-ESP-L
	Rock Island, IL 61299-5000
1	Commander
	US Army Aviation Systems Command
	ATTN: AMSAV-DACL
	4300 Goodfellow Blvd.
	St. Louis, MO 63120-1798
1	Director
	US Army Aviation Research
	and Technology Activity
	Ames Research Center
	Moffett Field, CA 94035-1099

No of Copies	Organization
1	Commander
	US Army Missile Command
	ATTN: AMSMI-RD-CS-R (DOC)
	Redstone Arsenal, AL 35898-5010
1	Commander
	US Army Tank Automotive Command
	ATTN: AMSTA-TSL (Technical Library)
	Warren, MI 48397-5000
1	Director
	US Army TRADOC Analysis Command
	ATTN: ATAA-SL
	White Sands Missile Range, NM 88002-5502
(Class. only) 1	Commandant
	US Army Infantry School
	ATTN: ATSH-CD (Security Mgr.)
	Fort Benning, GA 31905-5660
(Unclass. only) 1	Commandant
	US Army Infantry School
	ATTN: ATSH-CD-CSO-OR
	Fort Benning, GA 31905-5660
(Class. only) 1	The Rand Corporation
	P.O. Box 2138
	Santa Monica, CA 90401-2138
1	Air Force Armament Laboratory
	ATTN: AFATL/DLODL
	Eglin AFB, FL 32542-5000

Aberdeen Proving Ground

Dir, USAMSAA
ATTN: AMXSY-D
AMXSY-MP, H. Cohen

Cdr, USATECOM
ATTN: AMSTE-TO-F

Cdr, CRDEC, AMCCOM
ATTN: SMCCR-RSP-A
SMCCR-MU
SMCCR-MSI

Dir, VLAMO
ATTN: AMSLC-VL-D

No of Copies	Organization
2	Commander US Army Training and Doctrine Command ATTN: ATCD-N ATCD-T Fort Monroe, VA 23651
1	Commander US Army Forces Command ATTN: AFOP-TN Fort McPherson, GA 30330
1	Commander US Army Western Command ATTN: APO-NC APLG-MU Fort Shafter, HI 96858
1	Commander CFA (ROK/US) ATTN: C3-NBC APO San Francisco, CA 96301
1	Commander US Army Logistics Center ATTN: ATCL-MN Fort Lee, VA 23801
3	Commander US Army Laboratory Command Survivability Management Office ATTN: SLCSM-D SLCSM-C3I SLCSM-GS 2800 Powder Mill Road Adelphi, MD 20783-1145
1	Commander US Army Transportation Center and Fort Eustis ATTN: ATSP-PD-C (Chemical Officer) Fort Eustis, VA 23604
1	Commander US Army Aviation Center ATTN: ATZQ-D-MS Fort Rucker, AL 36362
1	Commander US Army Foreign Science Technology Center ATTN: AIAST-RA-ID2 Charlottesville, VA 22901

No of Copies	Organization
5	Commander Army Natick R&D Center ATTN: STRNC-A STRNC-I STRNC-U STRNC-YA STRNC-W Natick, MA 01760
1	Commander USAJFKSWC ATTN: ATSU-CD-CS Fort Bragg, NC 28307-5000
5	Commandant US Army Chemical School ATTN: ATZN-CM-FECD ATZN-CM-CS ATZN-CM-CT ATZN-CM-CC ATZN-CM-NF Fort McClellan, AL 36205
1	Commandant US Army Quartermaster School ATTN: ATSM-CDC Fort Lee, VA 23801-5037
4	Commander US Army Nuclear and Chemical Agency ATTN: MONA-NU MONA-CM MONA-WE MONA-SAL 7500 Backlick Road, Bldg. 2073 Springfield, VA 22150
3	Commander US Army TRADOC Analysis Center ATTN: ATRC-WDB ATRC-TSL White Sands Missile Range, NM 88002-5502
2	Director US Army TRADOC Analysis Command ATTN: ATRC-FWW ATZL-TIE Fort Leavenworth, KS 66027-5200
1	President US Army Armor & Engineer Board ATTN: ATZK-AE-TR Fort Knox, KY 40121-5470

No of Copies	Organization
1	Commanding General Wright Patterson Air Force Base ATTN: AFAMRL-HE Dayton, OH 45433
1	Commander US Army ARDEC ATTN: SMCAR-TDC Dover, NJ 07801-5001
1	Director US AMCCOM ARDEC CCAC Benet Weapons Laboratory Watervliet, NY 12189-4050
4	Commander US Army Dugway Proving Ground ATTN: STEDP-SD-TA-F STEDP-SD-TA STEDP-MT-CA-CB STEDP-MT-C Dugway, UT 84022
1	Commander CECOM R&D Technical Library ATTN: ASQNC-ELC-I-T, Myer Center Fort Monmouth, NJ 07703-5000
1	Office of the Secretary of Defense OATSD(AE) (Chemical Matters) Washington, DC 20301
1	Department of Defense OUSDRE(ELS) Room 3/D129, Pentagon Washington, DC 20301
1	Organization of Joint Chiefs of Staff ATTN: J-3 JOD (Col. Tripler) Washington, DC 20301
1	Director Armed Forces Medical Intelligence Center ATTN: AFMIC-ZA Fort Detrick, Frederick, MD 21701
1	Commander in Chief US European Command ATTN: ECJ5-N APO, NY 09128
1	Commander in Chief Pacific ATTN: J5414, Box 15 Camp Smith, HI 96861

No of Copies	Organization
1	Commander in Chief US Atantic Fleet ATTN: J338 Norfolk, VA 23511
1	Commander in Chief US Southern Command ATTN: SCJ3 APO Miami, FL 34004
1	Commander in Chief US Central Command ATTN: CCJ3-X MacDill AFB, FL 33608-7001
1	Commander in Chief US Special Operations Command ATTN: SOJ3-05 (Chemical Officer) MacDill AFB, FL 33608
1	Commander US Forces Japan ATTN: J3 APO San Francisco, CA 96301
1	Commander US Forces Korea ATTN: CJ-PL-N APO San Francisco, CA 96301
10	C.I.A. OIR/DB/Standard GE47 HQ Washington, DC 20505
3	Commander in Chief US Army Europe ATTN: AEAGC-NC-C APO, NY 09403
1	Director US Army Missile and Space Intelligence Center ATTN: AIAMS-YDL Redstone Arsenal, AL 35898-5500
2	Commandant US Marine Corps ATTN: POG-31 APW Room 2318, Arlington Annex Arlington, VA 20380
1	Battelle Edgewood Operations ATTN: F.T. Crimmins, Dir. CHIAC 2113 Emmorton Park Road Edgewood, MD 21040

No of Copies	Organization
1	Director Defense Intelligence Agency ATTN: DT-5A DX-7B DB-4G1 DB-1B2 Washington, DC 20301
1	AFELM, The Rand Corporation ATTN: Library-D 1700 Main Street Santa Monica, CA 90406
	Aberdeen Proving Ground
	Cdr, USATECOM AMSTE-SI-F AMSTE-TE-T
	Cdr, CRDEC, AMCCOM SMCCR-RSP SMCCR-TD SMCCR-TDT (Mr. Lawrence) SMCCR-ST SMCCR-PPD SMCCR-OPR SMCCR-NB
	Cdt, USAOC&S ATTN: ATSL-CDT ATSL-CD ATSL-CD-CS
	Dir, USAHEL ATTN: SLCHE-CC-LH

USER EVALUATION SHEET/CHANGE OF ADDRESS

This laboratory undertakes a continuing effort to improve the quality of the reports it publishes. Your comments/answers below will aid us in our efforts.

1. Does this report satisfy a need? (Comment on purpose, related project, or other area of interest for which the report will be used.) _____

2. How, specifically, is the report being used? (Information source, design data, procedure, source of ideas, etc.) _____

3. Has the information in this report led to any quantitative savings as far as man-hours or dollars saved, operating costs avoided, or efficiencies achieved, etc? If so, please elaborate. _____

4. General Comments. What do you think should be changed to improve future reports? (Indicate changes to organization, technical content, format, etc.) _____

BRL Report Number _____ Division Symbol _____

Check here if desire to be removed from distribution list. ____

Check here for address change. ____

Current address: Organization _____
Address _____

----------FOLD AND TAPE CLOSED----------

Director
U.S. Army Ballistic Research Laboratory
ATTN: SLCBR-DD-T(NEI)
Aberdeen Proving Ground, MD 21005-5066

OFFICIAL BUSINESS

NO POSTAGE NECESSARY IF MAILED IN THE UNITED STATES

BUSINESS REPLY LABEL
FIRST CLASS PERMIT NO. 12062 WASHINGTON D. C

POSTAGE WILL BE PAID BY DEPARTMENT OF THE ARMY

Director
U.S. Army Ballistic Research Laboratory
ATTN: SLCBR-DD-T(NEI)
Aberdeen Proving Ground, MD 21005-9989